

## Misuse of inhaler devices and associated factors in chronic obstructive pulmonary disease patients

Inhaler misuse and associated factors in COPD

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### Abstract

**Aim:** Inhaler device misuse is a common problem in the management of Chronic Obstructive Pulmonary Disease (COPD). In this study, we aimed to evaluate the incorrect use of inhaler devices and associated factors in patients with COPD.

**Material and Methods:** A total of 75 patients with the diagnosis of COPD were randomized. Demographic characteristics, type of device used, satisfaction with the drug, whether they received any training, and the inhalation technique were evaluated. Disease duration, pulmonologist follow-up, and device type were compared with the frequency and type of errors.

**Results:** Among the patients, 85.3% received information from the pulmonologist, 9.3% from another healthcare professional, and 5.3% did not receive any information about drug use; 20% of the patients were on Diskus, 4% on Turbohaler, 33.3% on capsuled devices, 37.3% pMDI, and 5.3% were on Ellipta. In total, 49.3% of patients were using their devices correctly. In patients who had 3 or more pulmonology follow-ups per year, correct installation of the device, mouth washing, and total correct use scores were significantly higher ( $p < 0.05$ ). Capsuled device users had significantly higher rates of performing adequate inhalation and the total score of correct use compared to pMDI users ( $p < 0.05$ ).

**Discussion:** In COPD patients, frequent follow-up and the type of device used were found to be related to correct inhaler use. Applied inhaler device training should be given by a pulmonologist both initially and during follow-up, with particular attention to the technique of using the pMDI.

### Keywords

COPD; Inhaler devices; Misuse; Patient education

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**Introduction**

Chronic obstructive pulmonary disease (COPD) is a disease characterized by the presence of airflow limitation, which is not completely reversible and is generally progressive. According to current estimates, the global burden of COPD will increase [1]. COPD was the fifth leading cause of death in the world in 2001 and is expected to be the third most common cause of death in 2020 [2]. Inhalation therapy plays an important role in the treatment of chronic obstructive pulmonary diseases, yet the correct device technique remains a barrier that can affect treatment outcomes [1]. Especially, in cases of recurring exacerbations and failure to control the disease despite treatment, the misuse of drugs plays an important role. Regardless of the type of device used, the rate of mistakes can reach 85%. For drugs to be effective, a sufficient amount of drug must be delivered to the bronchial mucosa. This is only possible with the correct technique. Among these devices, the most commonly used are pressured metered dose inhalers (pMDI) and dry powder inhalers (DPI). Hand-mouth coordination and simultaneous puff-inhalation should be achieved for patients to benefit from pMDIs effectively. A deep breathing maneuver is required for dry powder inhalers [3,4]. In this study, we aimed to evaluate the incorrect use of inhaler devices and associated factors in patients with COPD.

**Material and Methods**

This was a prospective study including 75 random patients who applied to the clinic of Abant University Faculty of Medicine, Department of Chest Diseases between May 2019 and August 2019 with a diagnosis of COPD and gave informed consent to participate the trial. Ethics approval was given by Abant University Faculty of Medicine with decision no:2018/126. Age, gender, education status, place of residence, duration of illness, smoking status, medicines taken, follow-up by a pulmonologist, type of device used, satisfaction with medication and adequate inhalation, correct breathing, mouth washing, and total scores were included in the study. The demographic characteristics of the patients, whether they received any training on the use of the inhaler device and who provided the training were recorded. The observation form was filled with questions about the steps of using the inhaler devices, which also inquires at what stage and why patients made mistakes. Patients' disease duration, pulmonology follow-up, and device preparation according to device type, adequate inhalation, breath-holding, mouth washing, and total score were evaluated. Social Sciences (SPSS Inc. Chicago, IL, USA) Mac-ios version 25 software program was used to evaluate the research data. Descriptive statistics are presented as numbers and percentages for categorical variables and mean ± standard deviation for numerical variables. When the Chi-Square condition was met for categorical variables, Pearson's Chi-Square (c2) or Fisher's Chi-square test was used for multiple and binary group comparisons. The statistical significance level was considered significant if the p-value was less than 0.05 with a 95% confidence interval.

**Results**

Most of the patients in our study were male (92%) with education less than high school (90.7%) and a mean age of 69.7±9.7 years. Among our patients, 69.3% were diagnosed more than 3 years ago, device instruction was given by a pulmonologist to 85.3% of the participants; 86.6% visited their pulmonologist more than once a year and 69.3% visited their pulmonologist more than three times a year. Most of the patients used capsuled devices (33.3%) or pMDIs (37.3%) (Table 1). Most of the patients thought their treatment was effective (77.7%), and most of them were satisfied with their medicine (78.7%) (Table 2). Most of the patients were setting up their device correctly, performed adequate inhalation, held their breath correctly, and washed their mouths, yet looking at the total scores, half the patients were making at least one mistake (Table 2).

**Table 1.** Demographic characteristics

Parameter	Number (%)
Sex (male)	69 (92%)
Mean age, years	69.7±9.7
Residency	
City	33 (44%)
Rural	42 (56%)
Level of education	
None	4 (5.3%)
Can read and write	4 (5.3%)
Elementary school	51 (68%)
Middle school	9 (12%)
High school	3 (4%)
University	4 (5.3%)
Active smoker	17 (22.6%)
Duration of disease	
0-3 months	7 (9.3%)
3 months - 1 year	3 (4%)
1 - 3 years	13 (17.3%)
≥3 years	52 (69.3%)
Device described by	
Pulmonologist	64 (85.3%)
Internal diseases specialist	2 (2.7%)
General practitioner	1 (1.3%)
Pharmacist	4 (5.3%)
No one	4 (5.3%)
Frequency of pulmonology follow up	
Once a year	21 (28%)
≥3 times a year	46 (61.3%)
None	8 (10.7%)
Device used	
Diskus	15 (20%)
Turbohaler	3 (4%)
Capsuled device	25 (33.3%)
pMDI	28 (37.3%)
Ellipta	4 (5.3%)

**Table 2.** Treatment perception and technical mistakes

Parameter	Number (%)
<b>Is the drug effective</b>	
Yes	58 (77.3%)
Partially	10 (13.3%)
No	6 (8%)
Don't know	1 (1.3%)
<b>Are you satisfied with the drug</b>	
Yes	59 (78.7%)
Partially	8 (10.7%)
No	8 (10.7%)
<b>Setting up the device correctly</b>	
Adequate inhalation	64 (85.3%)
Breath-holding	50 (66.7%)
Mouth washing	47 (6.27%)
<b>Total score</b>	
Correct use	37 (49.3%)
Misuse	38 (50.7%)

Comparing the individual mistakes and total score with different parameters, we found that the duration of disease did not affect the correct use of the inhalers. Frequent pulmonology follow-up improved inhaler use. Patients who were followed by a pulmonologist at least three times a year were less likely to make mistakes compared to patients who had no follow up (setting up p=0.01, mouth washing p=0.034, total score p=0.041). The device type also had a statistically significant relation with mistakes. Patients on pMDI were more likely to make inhalation mistakes (p<0.001). The total correct usage score was higher in patients using capsules, and the total misuse score was higher in patients using the pMDI (p=0.007). There was no statistically significant difference between those using capsules devices or pMDI and those using Diskus, Turbohaler, or Ellipta (Table 3).

**Discussion**

The main treatment for COPD is the administration of bronchodilators and corticosteroids using an inhaler. The most important advantage of using medication through inhalation is that it provides more optimal treatment by using less medication, a higher concentration of drugs can be administered more effectively to the airways and, especially, the systemic side effects of corticosteroids can be reduced [1]. The pMDIs contain active substances in liquid form in a pressure tube, after activation, the drug can reach bronchial mucosa via a deep inhalation. Hand-breath coordination and spray-inhalation synchronization are required for a correct maneuver. These devices are generally believed to be hard to use. Dry powder inhalers reach the bronchial mucosa through deep inhalation of the powder. They do not require hand-breath coordination and synchronization but are more expensive [5,6]. Errors in inhaler drug applications affect the effectiveness of treatments. Especially in the occurrence of asthma and COPD exacerbations and lack of adequate control, errors in inhaler drug applications are of great importance [7-12].

In a study published in 2018, Ozel et al. evaluated 84 patients with COPD or asthma for satisfaction and ability to use inhalation devices [13]. They found that the skill to use the devices correctly was higher in those with high school or higher education. Individuals who learned how to use the device from a pulmonologist had higher scores on the device's correct use. It was found that the correct use of the drug is lower in patients with a disease duration of 11 years or more. The skill points were lower in pMDI users than in other devices, and mouthwash and breath-hold accuracy rates were less than 50% [13]. In our study, 78.7% of the patients were satisfied with the medication, and this rate was higher than that of Ozel et al. The reason for this may be because our patients were generally trained by a pulmonologist.

**Table 3.** The relation between parameters and mistakes

	Setting up		Adequate inhalation		Breath-holding		Mouth washing		Total score	
	Correct	Wrong	Correct	Wrong	Correct	Wrong	Correct	Wrong	Correct	Wrong
<b>Duration of disease</b>										
0-3 m (n=7)	100.0%	0.0%	85.7%	14.3%	85.7%	14.3%	71.4%	28.6%	71.4%	28.6%
3m - 1y (n=3)	66.7%	33.3%	100.0%	0.0%	100.0%	0.0%	66.7%	33.3%	33.3%	66.7%
1-3 y (n=13)	100.0%	0.0%	92.3%	7.7%	69.2%	30.8%	53.8%	46.2%	53.8%	46.2%
≥3y (n=52)	96.2%	3.8%	82.7%	17.3%	61.5%	38.5%	63.5%	36.5%	46.2%	53.8%
<b>Pulmonology follow up</b>										
≥3 times a year (n=46)	100.0%*	0.0%	87.0%	13.0%	67.4%	32.6%	71.7%*	28.3%	58.7%*	41.3%
Once a year (n=21)	95.2%	4.8%	85.7%	14.3%	66.7%	33.3%	57.1%	42.9%	42.9%	57.1%
None	75.0%	25.0%	75.0%	25.0%	62.5%	37.5%	25.0%	75.0%	12.5%	87.5%
<b>Device</b>										
Diskus (n=15)	93.3%	6.7%	100.0%	0.0%	73.3%	26.7%	73.3%	26.7%	60.0%	40.0%
Turbohaler (n=3)	66.7%	33.3%	100.0%	0.0%	66.7%	33.3%	33.3%	66.7%	0.0%	100.0%
Capsuled device (n=25)	100.0%	0.0%	100.0%	0.0%	76.0%	24.0%	72.0%	28.0%	68.0%*	32.0%
pMDI (n=28)	96.4%	3.6%	60.7%*	39.3%	53.6%	46.4%	46.4%	53.6%	28.6%	71.4%*
Ellipta (n=4)	100.0%	0.0%	100.0%	0.0%	75.0%	25.0%	100.0%	0.0%	75.0%	25.0%

\*p<0.05, pMDI: Pressure metered dose inhaler

In our study, no relationship was found between disease duration and correct use rate, in contrast to the results of Ozel et al. This may be due to the training by a pulmonologist and the frequency of follow-up in our study. Consistent with Ozel et al, our study showed a significantly higher rate of pMDI misuse, possibly due to the age of COPD patients and the difficulty of pMDI use.

In the study of 751 asthma and COPD patients, published in 2018 by Baslılar et al., the rate of non-use and misuse of the device was found to be higher in patients with disease duration of 0-3 months compared to 3 months-1 year, 1-3 years and 3 years longer. Also, in illiterate people, the rate of misuse was higher. The pMDI users made more mistakes compared to those using the Diskus, capsuled devices, and Turbohaler [14]. In our study, no relationship was found between the duration of the disease and the correct use of the drugs. The difference from Baslılar et al. is probably due to the difference between the number of patients.

In a study including 122 COPD and asthma patients published by Çörtük et al. in 2014, the correct use rate was found to be highest with Diskus at 88.2%, 85.7% with the capsuled devices, 46.3% with pMDI and the lowest in Turbohaler with 30%. There was no relationship between the duration of the disease and the correct use of the drugs [15].

In a study published by Aydemir et al. in 2012, 300 patients with COPD and asthma were evaluated for the misuse of inhaled devices, related factors, and the role of education. The correct device usage rates were 57% in Diskus, 53% in capsuled devices, 51% in Turbohaler, 55% in Easyhaler, and 13% in pMDI. Correct usage was highest with Diskus and lowest with pMDI. Correct use was significantly higher when the device training was provided by a pulmonologist compared to internal medicine specialists and pharmacists. The correct use of the drug was found to be higher in those who were followed-up by a pulmonologist [16].

A study published in 2001 by Mirici et al. investigated factors affecting the inhalation technique in 153 people with obstructive airway disease. In all devices, the most common errors were breath-holding and exhalation before the second dose. No difference was observed between the devices in terms of correct use. The person who taught patients the device caused no significant change. While the level of education increased the score of correct use, the duration of use decreased it [17]. In our study, the highest error rate was with pMDIs, and the highest correct use rate was with capsuled devices. There was no significant difference in those using other devices.

The average age in our study was 68 years, which was higher than that of Ozel, Başlılar, Çörtük et al. [13-15]. The reason for the high average may be that COPD is a lung disease affecting the advanced age group, and older age is among the risk factors for disease development. Another reason for this may be because our study did not include asthma patients.

In our study, the ratio of male patients (72.6%) was higher compared to similar studies by Çam, Mirici et al. [17,18]. Gender ratios in our study are incompatible with the literature. Possible reasons for this may be that our country is a developing country or that most of the patients in our study were living in rural areas.

In our study, a significant relationship was observed between the frequency of follow-up by the pulmonologist and the correct use of the device. Also, correct inhalation and correct use of total scores were significantly higher in patients using capsuled devices than in pMDI users. The main problem encountered with inhaler devices, including pMDIs, is the difficulties of the inhalation technique. Therefore, the correct technique should be taught by or under the supervision of a pulmonologist. All COPD patients should be treated and followed up by a pulmonologist. Applied inhaler device training should be given to patients at the beginning of the treatment and the controls, and it should be ensured that the patient is using the drug correctly. With enough focus on the problem, it seems possible to achieve a solution through regular patient education and follow-up.

#### Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

#### Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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#### Conflict of interest

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